GENiC

Addendum to deliverable D5.2
Energy Use Cases, Measurement Methodology & Energy Baseline for the Demonstration Sites

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Author(s)	:	Ignacio Torrens (TUe); Juan R. de las Cuevas (ACCIONA)
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Abstract

Following the submission and review of the re-submitted Deliverable 5.2 in year 2 (originally from Y1) of the GENiC project, an addendum to the original deliverable text was requested to further the discussion on a few topics raised by the reviewers following conditional approval. The comments from the reviewers are presented, followed by the response from the consortium addressing each of the remarks.

Keyword list

Demonstration sites, use cases, measurement methodology, energy baseline

Document History

Date	Revision	Comment	Editors	Affiliation
Feb 10, 2016	1	Template and preliminary info	Ignacio Torrens	TUE
Feb 18, 2016	2	ACCIONA's answers included	Ignacio Torrens	TUE
Apr 14, 2016	2.1	Final edits	Ignacio Torrens	TUE
Apr 25, 2016	2.2	Internal Review	Enric Pages, Dirk Pesch	ATOS, CIT
Apr 27, 2016	2.3	Minor edits	Ignacio Torrens	TUE
Apr 28, 2016	2.4	Integration of edits from ACCIONA to remark 3 and 5	Ignacio Torrens	TUE

Executive Summary

The aim of the GENiC project is to develop an integrated management and control platform for data center wide optimization of energy consumption by integrating monitoring and control of computation, communication, data storage, cooling, local and renewable power generation, energy storage, and waste heat recovery. The platform will include open interfaces and a common data format, and provide control and optimization functions and decision support tools to achieve a substantial reduction in energy consumption.

The fundamental premise of GENiC is that the energy consuming equipment in data centers must be supplemented with renewable energy generation and energy storage equipment and operated as a complete system to achieve an optimal energy and emissions outcome. This vision is centered on the development of a hierarchical control system to operate all of the primary data center components in an optimal and coordinated manner. The goal is to minimize energy use through manipulation of local equipment controller set points and provision of optimized control of computing load and cooling distribution.

This document outlines the demonstration sites, their operation before and after implementation of the GENiC platform, the methodology used for conducting measurements in the demonstration sites and the measured energy baseline for the sites.

The demonstration sites include two date centres (DCs) on the CIT campus in Cork, Ireland as well as two existing research demonstration sites for RES in Spain. Both existing meters and additional metering were used for measuring the relevant parameters for describing the baseline operation of the sites in terms of IT workload, the thermal conditions inside the DC space as well as the power consumption of the DC as a whole. All measurement results available at the time this report was written are presented in detail while additional details for some sections can be found in other GENiC deliverables.

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1 Reviewers remarks

From the Technical review report of the Year 2 review:

“This document describes the demonstration sites, their operation before and after implementation of the GENiC platform, the methodology used for conducting measurements and the measured energy baseline for the sites.

Comments

1. The heat recovery potential for the demo DC described in paragraph 2.1.1.3 looks like a proposal an energy consultant would make to the DC manager. It lacks energetic and financial evaluation of the measures proposed. The latter must be provided.
2. It would be interesting to give data on the physical dimensions of the absorption chiller and the COP it operates. The physical dimensions should be compared to those of the DC. In this way, future DC managers will get an idea of what extra space they need to install absorption chillers like the ones the project proposes. In the same view, it would be interesting to give the volume of the machine room shown in Fig. 2.19 and correlate it with the volume of a DC it would serve.
3. The suggestions mentioned on page 26 are already known. Is there something beyond the state of the art that is proposed?
4. As shown in Fig. 4.27 the electrical efficiency of the ORC systems is extremely low. Will the project finally suggest such units in DC? If yes, what is the economic evaluation of such systems?
5. How useful is a COP<1.2 as shown in Fig. 4.29? An analysis (technical and economic) of systems with low efficiencies must be provided to prove that they are viable for DC (taking into account their physical dimensions too).

Although this deliverable offers nothing new, it is in line with the DoW. For this reason it is accepted. An amendment providing answers to the above comments must be submitted.”

2 Response to the remarks

This deliverable was a resubmission from year 1 and it should have been evaluated based on the correction we were requested to make following the year 1 review comments rather than being seen as a year 2 deliverable. However, the reviewers may not have realized that it was a resubmission incorporating comments from the year 1 review and it should have been reviewed on the basis of the consortium appropriately addressing the year 1 review comments. We would like to make the following observations:

1. According to Y1 review recommendations, the content of the deliverable meets DoW objectives, but it was amended to take into consideration new content that needs to be provided in deliverable D1.3 regarding the Heat Recovery solutions that could be considered for our real demo site C130.
2. The deliverable covers the real sites used in the GENiC prototype, the document is not considering general solutions for different types of data centers or making general statements about how the measurements process should be carried out in other types of DC.

Based on these observations, the GENiC consortium will address the remarks related to year 1 work in this addendum, but will point to upcoming deliverables of WP6: “Demonstration”, where the remaining remarks, out of scope for this year 1 deliverable, will be addressed in detail.

2.1 Remark 1: ‘Heat recovery system’

“The heat recovery potential for the demo DC described in paragraph 2.1.1.3 looks like a proposal an energy consultant would make to the DC manager. It lacks energetic and financial evaluation of the measures proposed. The latter must be provided”

Response:

A techno-economic analysis of the implemented solution will be provided in D6.1: ”Heat recovery results” (M36)

However, preliminary dimensioning performed on the C130 facilities show that the best option to install a heat recovery system is to transfer heat from the data center room to the cantina atrium, close to the data centre and with need of heating for most past of the year.

Other two alternatives were considered to recover the heat from the data center, and these are the following;

- Use of Waste Heat to Feed Domestic Hot Water System: Rejected due to long distances, high prices and legionella risk by the low enthalpy and temperature.
- Use of Waste Heat to Feed the Serving Atrium air handling unit: This is the selected option.
  Energetic and financial justification: This option represents a greater proportion of the available waste heat being used but the demand is seasonal and therefore the benefit would only be obtainable for 5-6 months of the year. An atrium space such as this would typically have a heat load of 50kWh/m2/yr. Based on drawings received from CIT the area of B Atrium-E is approximately 800m2. The total heat demand of the atrium is therefore 40MWh/yr. All in all, if 20% of the heat is recoverable (11kW) from the EDPAC unit due to external non-ideal conditions and this is used to provide regular heat to the atrium overnight in the heating season then the available heat equates to 11kW x 12hrs = €7/day (based on space heating cost of €0.05/kWh). Assuming these

conditions are suitable for 6 months of the year and 120 occupied days, we get around €800/yr. saved.

- Estimated Cost of Works: €10,500 incl. Builders Works
- Simple payback: 8.5 years

All these numbers will have to be verified via monitoring in the 6.1. deliverable to be submitted at the end of the Project.

- Hybrid of Two Systems Above; This was the 3rd option on the table, and by the reasons of the fist bullet, it was rejected as well.

2.2 Remark 2: ‘Absorption chiller’

“It would be interesting to give data on the physical dimensions of the absorption chiller and the COP it operates. The physical dimensions should be compared to those of the DC. In this way, future DC managers will get an idea of what extra space they need to install absorption chillers like the ones the project proposes. In the same view, it would be interesting to give the volume of the machine room shown in Fig. 2.19 and correlate it with the volume of a DC it would serve”

Response:

The physical dimensions of the absorption chiller will depend on the power range, the 2 installed in trigeneration site in Sevilla have a size of 1 x 1,5 x 2,30 m with chilling power of 24 kW each.

It has to be taken into account, that absorption machines are a component of a larger system that comprises more equipment and processes. The space to be reserved will depend on the configuration selected and this will be related to the location, building typology, RES available and other boundaries conditions.

In figure 2.19 the warehouse space dimensions are 26 x 9 x 5 m, but this is not relevant as it’s an experimental facility.

Figure 2.19: Hydraulic installation (*extracted from D5.2*)

2.3 Remark 3: 'Solutions beyond State of the art'

"The suggestions mentioned on page 26 are already known. Is there something beyond the state of the art that is proposed?"

Response:

No, these are the best suitable options available when working with an experimental plant. In principle, the innovation side of the applications are related to the low enthalpy of the heat recovered, and the application of these to Data Centres. There is not a clear breakthrough though, but an innovative application based on an experimental plan operation.

2.4 Remark 4: 'ORC'

"As shown in Fig. 4.27 the electrical efficiency of the ORC systems is extremely low. Will the project finally suggest such units in DC? If yes, what is the economic evaluation of such systems?"

Response:

ORC machine in the experimental plant has an overall efficiency of 95%. Around 10% of the thermal input is converted into electricity and most of the rest is useful heat at low temperature (from 20 to 70ºC). The efficiency of commercial ORC goes from 8 to 24% but what needs to be considered is the overall effect of the machine in the facilities, not only the electrical output.

In relation to suggesting ORC for data centres, this will be an outcome of WP6, which is still ongoing.

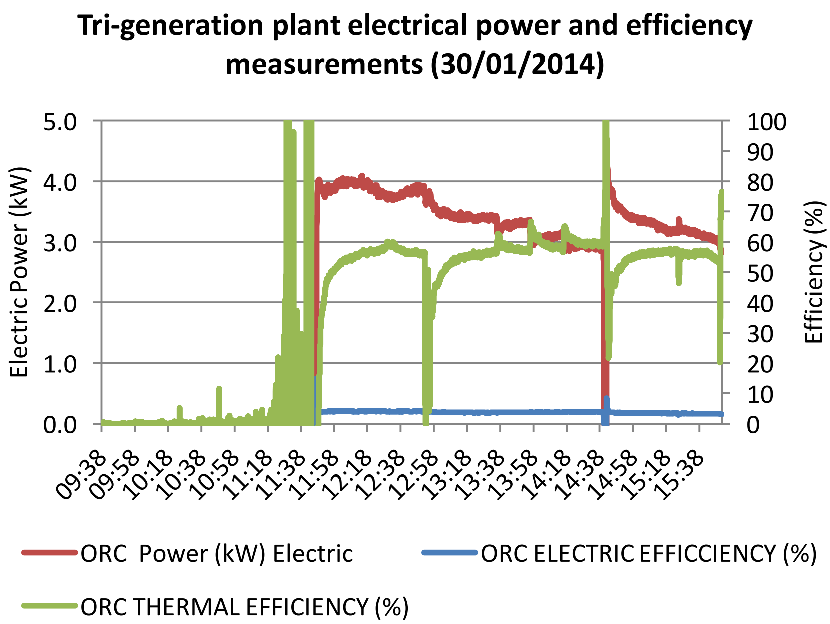

Figure 4.27: Tri-generation plant electrical power and efficiency measurements (30/01/2014) (*extracted from D5.2*)

2.5 Remark 5: ‘Techno-economic analysis of systems’

“How useful is a COP<1.2 as shown in Fig. 4.29? An analysis (technical and economic) of systems with low efficiencies must be provided to prove that they are viable for DC (taking into account their physical dimensions too)”

Response:

Again, a value of 1,2 is the COP of the absorption chiller, which is just one component of a larger system. 1.2 is a normal COP for that technology, and the technical and economic analysis will have to be focused on the whole system, not only in one of the components, and this analysis is another outcome of WP6 that is currently ongoing. Results will be presented in Deliverable 6.2.:”Strategies validation at tests beds”

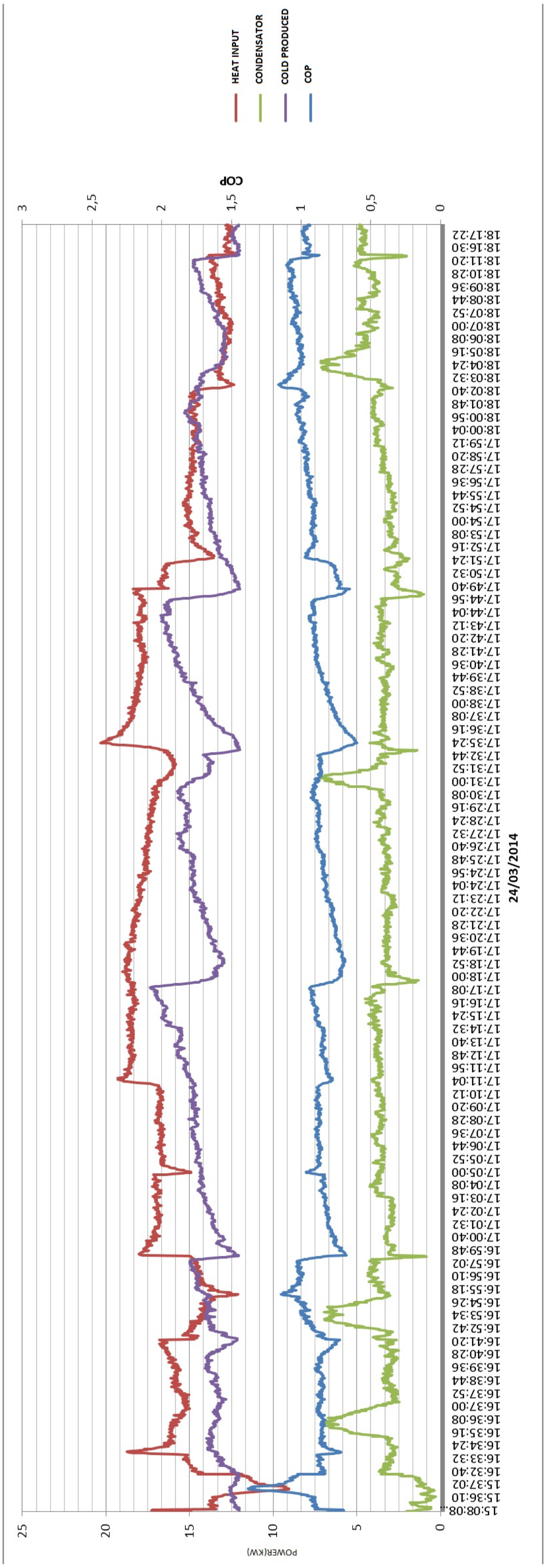

Figure 4.29: Tri-generation plant absorption chiller heat input, condenser power, cold production and COP measurements (24/03/2014) (*extracted from D5.2*)